

1 **Public perspectives on social distancing and other protective measures in Europe: a cross-sectional**  
2 **survey study during the COVID-19 pandemic**

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51 **ABSTRACT**

52 **Objectives:** The extent to which people implement government-issued protective measures is critical in  
53 preventing further spread of coronavirus disease 2019 (COVID-19) caused by coronavirus SARS-CoV-2.  
54 Our study aimed to evaluate the public belief in the effectiveness of protective measures, the reported  
55 implementation of these measures in daily life, and to identify communication channels used to acquire  
56 relevant information on COVID-19 in European countries.

57 **Design:** A cross-sectional online survey available in multiple languages was disseminated on social media  
58 starting March 19th, 2020. After five days, we computed descriptive statistics for countries with more than  
59 500 respondents. Each day, we compiled and categorized community containment measures enacted in  
60 each country by stringency (stage I-IV). Response collection continued for one week to explore possible  
61 dynamics as containment strategies intensified.

62 **Participants:** In total, 9,796 adults responded, of whom 8,611 resided in the Netherlands (stage III), 604  
63 in Germany (stage III), and 581 in Italy (stage IV). An additional 1,365 respondents completed the survey  
64 in the following week.

65 **Results:** Participants indicated support for governmental measures related to avoiding social gatherings,  
66 selective closure of public places, and hand hygiene and respiratory measures (range for all measures:  
67 95.0%-99.7%). Respondents from the Netherlands were less likely to consider a complete social lockdown  
68 effective (59.2%), compared to respondents in Germany (76.6%) or Italy (87.2%). Italian residents did not  
69 only apply enforced social distancing measures more frequently (range: 90.2%-99.3%, German and Dutch  
70 residents: 67.5%-97.0%), but also self-initiated hygienic and social distancing behaviors (range: 36.3%-  
71 96.6%, German and Dutch residents: 28.3%-95.7%). Respondents largely reported being sufficiently  
72 informed about the COVID-19 outbreak and about behaviors to avoid infection (range across countries:  
73 90.2%-91.1%). Information channels most commonly reported included television (range: 53.0%-82.0%),  
74 newspapers (range: 31.0%-63.0%), official health websites (range: 39.0%-54.1%), and social media  
75 (range: 40.0%-55.8%). We observed no major changes in answers over time.

76 **Conclusions:** In European countries, the degree of public belief in the effectiveness of protective  
77 measures was high and residents reported to be sufficiently informed by various communication channels.  
78 In March 2020, implementation of enacted and self-initiated measures differed between countries and  
79 were highest among Italian respondents, who were subjected to the most elaborate measures of social  
80 lockdown and greatest COVID-19 burden in Europe.

81 **Keywords:** COVID-19, SARS-CoV-2, Survey, Public Behaviour, Pandemic, Mitigation

## 82 INTRODUCTION

83 The recent pandemic of COVID-19 (coronavirus disease 2019) caused by SARS-CoV-2 (Severe  
84 Acute Respiratory Syndrome Coronavirus 2) has infected more than 1,000,000 people worldwide in only a  
85 few months' time and caused more than 51,000 deaths as of April 2nd, 2020[1]. This rapidly spreading  
86 virus imposes a tremendous burden on national healthcare systems, as they lack sufficient material and  
87 human resources to respond to the rapidly increasing number of patients requiring intensive care[1,2].  
88 Worldwide, public health organizations, as well as national and international government bodies, have  
89 suggested systematic implementation of protective, public health measures in an effort to delay the spread  
90 of COVID-19[3]. The aim of these measures is to decrease the peak infection rate, while maintaining a  
91 high quality of care under finite resources and limited hospital capacities[2,4]. In addition to basic  
92 hygienic advice such as regular hand washing, the most important recommendation known to limit and  
93 delay the spread of the virus is social (physical) distancing[5,6].

94 In early March 2020, Europe became the epicenter of the COVID-19 pandemic, with more cases  
95 and deaths reported than in all other countries (excluding China) combined[1]. Throughout the course of  
96 the month, most European countries progressively implemented community isolation measures to increase  
97 social distancing, such as imposing work restrictions and the closure of public places and shops. Italy, the  
98 first and most severely affected country in Europe, imposed strict community isolation measures on March  
99 9th and 11th, 2020, enforcing a nationwide quarantine in response to the alarming increase in the number  
100 of cases, which posed a serious threat to the capacity of the Italian healthcare system[7].

101 The extent to which people are informed about and apply the measures advocated by experts and  
102 enforced by governments is critical to control the spread of the virus and to optimize patient outcomes  
103 during the current COVID-19 pandemic[4,8,9]. The aim of our study was to evaluate public belief in the  
104 effectiveness of protective measures, to what extent individuals have implemented these measures in their  
105 daily lives, and to identify key communication channels used to acquire information on COVID-19 in  
106 European countries. We believe these insights are not only valuable for the ongoing mitigation of the  
107 current COVID-19 pandemic, but may also serve to inform governments' and public health organizations'  
108 information dissemination and infection control strategies for possible future pandemics.

## 109 **METHODS**

### 110 *Design, setting, and participants*

111 The survey instrument used to gather cross-sectional data was compiled by a team of medical  
112 students and epidemiologists from the Leiden University Medical Center and the Charité -  
113 Universitätsmedizin Berlin. Our initial aim was to collect sufficient data on adults living in Europe, with  
114 an emphasis on individuals residing in the Netherlands, Germany, and Italy, however, the survey was also  
115 open to residents of other countries. Data collection is still ongoing and is planned to continue for as long  
116 as community isolation measures remain in place. In these primary descriptive analyses, we only reported  
117 data from countries with at least 500 responses at our first cut-off date, March 23rd, 2020. This date was  
118 chosen because several European regional and national governing bodies announced stricter measures  
119 around this date. The study was reviewed and granted exempted status from medical ethical approval by  
120 the Institutional Review Board of Leiden University Medical Center in The Netherlands (protocol number:  
121 N20-037).

### 122 *Survey instrument*

123 We selected questions from the validated Flu TELEphone Survey Template (FluTEST), which was  
124 designed to assess perceptions and behavior during an influenza pandemic [10]. We slightly modified the  
125 items to fit the current outbreak context, where necessary and formulated additional questions to assess  
126 beliefs in the effectiveness of protective measures [11]. In brief, the survey instrument consisted of 22  
127 items in three sections including: 1) five questions regarding beliefs in the effectiveness of public  
128 measures to reduce outspread (e.g. selective closure of places and complete social lockdown), 2) 16  
129 questions on the personal application of protective measures (e.g. social distancing behaviors and hygienic  
130 practices), and 3) one question on the three most frequently used sources to acquire information on the  
131 COVID-19 outbreak, and one question on the perception whether or not respondents felt sufficiently  
132 informed. The full survey is presented in Supplemental Text 1. To allow for stratified interpretation of the  
133 results, additional questions captured sociodemographic information about gender, age, household  
134 composition, employment status, educational level, country of residence, being a healthcare provider or  
135 (bio)medical student, and prevalent chronic medical conditions. Respondents were able to complete the  
136 questionnaire only once per device in an effort to reduce potential repeat responses.

137 The survey was translated into multiple languages by a small panel of native speakers from the  
138 original English language version. Due to time constraints, we were unable to formally validate the survey  
139 questions in the other languages. The survey went live on March 19th, 2020 in Dutch, English and  
140 German. Other languages have been added since initiation (Italian on March 20, 2020; French and Polish

141 on March 21, 2020; Spanish on March 22, 2020; Turkish on March 25, 2020; and Farsi on March 29,  
142 2020; see Supplemental Text 1).

### 143 *Procedures*

144 The full survey was initially piloted on a sample of 50 respondents. After minor modifications to  
145 the structure and language, the survey was actively disseminated through (social) media channels, such as  
146 WhatsApp, Telegram, Facebook, LinkedIn, Instagram, and Twitter, and in professional networks via  
147 electronic mailing lists. The survey was further promoted via a number of local and national news  
148 websites and radio stations. On the landing page, participants were briefed about the study and only those  
149 providing informed consent for participation were guided to the actual 5-minute survey. On the final page,  
150 participants were debriefed about the study, and thanked for their contribution.

151

### 152 *Assessment of stages of community containment measures*

153 We extracted community containment measures taken by governments in each country included  
154 in this study from national governmental announcements and news articles and compiled daily from  
155 March 1st, 2020 onwards. Two independent researchers classified stringency of isolation measures by  
156 country in four stages based on the Community Containment Measures guideline originally developed by  
157 the Centers for Disease Control and Prevention (CDC) during the SARS outbreak in 2003[12]. Any  
158 disagreement was resolved by discussion. The CDC guideline describes seven interventions, which we  
159 grouped into four stages to create country-specific timelines for the purposes of this study. Guideline  
160 interventions 1 (passive monitoring), 2 and 3 (active monitoring without and with activity restrictions,  
161 respectively) were grouped together as Stage I (“Low Impact Containment Measures”), since most  
162 countries had already implemented these interventions in early March 2020. Guideline interventions 4  
163 (working quarantine) and 5 (focused measures) were grouped and classified as Stage II (“Focused  
164 Measures to Increase Social Distance”), as many countries applied these interventions simultaneously. We  
165 designated intervention 6 as Stage III (“Community-Wide Measures to Increase Social Distance”) and  
166 intervention 7 as Stage IV (“Widespread Community Quarantine, Including Cordon Sanitaire”). We  
167 detailed and justified the daily stage classification by country in a series of timelines (Supplemental Tables  
168 1a-1d; Supplemental Text 2).

### 169 *Statistical Analyses*

170 Data collected over a five-day period between March 19th, 2020 and March 23th, 2020 at 11:20  
171 AM (UTC+0), were used in the primary analyses. We present results of the survey items including

172 sociodemographic characteristics using descriptive summary statistics for the countries having more than  
173 500 responses during this primary data collection period (the Netherlands, Germany, and Italy). Nominal  
174 variables were described and visualized using frequencies and percentages. We also reported frequencies  
175 of missing responses. We present stratified results for the assessed sociodemographic variables only for  
176 the Netherlands, as the number of responses was sufficient per individual subgroup. No formal statistical  
177 comparisons were made between countries since the primary aim was descriptive and there were no *a*  
178 *priori* testable hypotheses.

179         As a secondary analysis, we explored changes in responses for items about the beliefs in the  
180 effectiveness of these measures and their implementation over time. As for items about implementation of  
181 protective measures, we reported the proportion of positive answers (“Yes”) out of all responses,  
182 excluding responses indicating the question was not applicable to their situation. Similarly, for items about  
183 the belief in effectiveness of these measures, we considered the proportion of positive answers (“Probably  
184 true”). To easily visualize the change over time, we modeled the proportions for each item and for each  
185 country separately, using generalized additive models with time as the independent variable, using a  
186 shrinkage version of cubic splines with three knots. In addition, we computed and presented visualizations  
187 of the differences in proportion between the responses recorded during the primary data collection period  
188 and the weeklong extension only for the Netherlands.

189         Data management, analyses and visualizations were conducted using Stata 16.1 (StatCorp LP,  
190 College Station, TX) software and R 3.6.3 / RStudio 1.2.

191

## 192 **RESULTS**

193  
194 Between March 19th and 23rd, 2020, a total of 9,796 respondents completed the survey. Three  
195 countries met our study inclusion criteria of more than 500 respondents; the Netherlands (n=8,611),  
196 Germany (n=604), and Italy (n=581) (see flowchart: Figure 1). During this primary data collection period,  
197 the containment measures in the Netherlands and Germany met criteria for Stage III classification  
198 (“Community-Wide Measures to Increase Social Distance”), and those in Italy met Stage IV criteria  
199 (“Widespread Community Quarantine”).

200 Most respondents opened the survey link via WhatsApp or Facebook (Figure 1). Approximately  
201 two-thirds of respondents were female and one-third of respondents were aged 21-30 years old (Table 1).  
202 The majority of respondents had a paid job (57.1%) and many had tertiary academic degrees (68.2%)  
203 Approximately 18% of respondents were healthcare providers or (bio)medical students. Less than one-  
204 fifth of respondents reported suffering from a chronic illness or being in poor medical condition (17.3%).  
205 Descriptive sociodemographic characteristics stratified by country of residence are presented in Table 1.

206

### 207 **Sources used to acquire information on the COVID-19 outbreak**

208

209 Among respondents living in the Netherlands, Germany, or Italy, the most frequently used sources  
210 to obtain relevant information included television (e.g. news, range: 53.0%-82.0%), newspapers or news  
211 applications (range: 31.0%-63.0%), social media (e.g. Facebook and Twitter, range: 40.0%-55.8%), and  
212 official health websites (range: 39.0%-54.1%). Other people (e.g. family, friends and colleagues, range:  
213 23.9%-26.7%) and radio were reported less frequently as sources of information (range: 5.3%-26.7%). In  
214 all three countries, healthcare professionals (range: 4.3%-7.6%) and official health hotlines (range: 1.2%-  
215 1.6%) were the least frequently reported sources of information (Table 1). Almost all respondents living in  
216 these three countries reported being sufficiently informed about the current COVID-19 outbreak and what  
217 they could do to prevent an infection (range: 90.2%-91.1%; Table 2).

218

### 219 **Belief in the effectiveness of measures to reduce outspread**

220

221 The majority of respondents believed that avoiding social gatherings, selective closure of public  
222 places and locations, hand hygiene measures, and respiratory measures were effective ways to prevent  
223 further spread of COVID-19 (range for all measures in all three countries: 95.0%-99.7%; Table 2). Only  
224 59.2% of respondents in the Netherlands perceived a complete social lockdown or isolation measures as



225 effective, compared with 76.6% of respondents from Germany and 87.2% from Italy (Figure 2 and Table  
226 2).

227

### 228 **Individual implementation of protective measures**

229

230 For all items, the percentages reported in the text and Table 3 excluded respondents to whom the  
231 item did not apply, which was especially important in the interpretation of three items (keeping children at  
232 home before any mandates were put in place, range: 41.0%-75.1%; reducing the use of public transport,  
233 range: 1.9%-28.5%; and going to school/university/work, range: 2.4%-14.9%). With regard to personal  
234 protective behaviors, a high number of respondents from the Netherlands and Germany reported to have  
235 washed their hands with soap and water more often than usual (range: 95.0%-95.7%). In general,  
236 respondents from Italy reported applying all proposed personal protective behaviors more often than those  
237 from the Netherlands or Germany, except for following a healthy diet or using vitamin supplements  
238 (36.3%, Netherlands 54.5%, Germany 54.4%) (Figure 3 and Table 3).

239 Behavior related to limiting interactions with people was fairly similar between countries,  
240 although respondents from Italy reported more frequently cancelling or postponing social events (98.8%,  
241 compared with 94.8% in the Netherlands and 97.0% in Germany) and avoiding crowded places more  
242 frequently (99.3%, compared with 92.4% in the Netherlands and 93.8% in Germany). Respondents living  
243 in Germany reported avoiding people with cold or flu-like symptoms (81.1%) less frequently than  
244 respondents living in Italy (90.2%) or in the Netherlands (89.0%). Regarding behaviors related to avoiding  
245 travel, respondents from Italy more often reported to have reduced the amount they went to school or  
246 work (94.4%, compared to 88.0% in the Netherlands and 84.9% in Germany, of public transport use  
247 (98.6% compared to 89.6% in the Netherlands and 91.3% in Germany), and of going to shops (97.7%,  
248 compared to 81.4% in the Netherlands and 67.5% in Germany) (Figure 3 and Table 3). Responses to  
249 questions concerning limiting interactions and avoiding traveling may reflect both imposed restrictions  
250 and respondents' awareness and willingness to follow protective measures. Therefore, we additionally  
251 asked respondents whether they kept children at home prior to formal mandates to assess the percentage of  
252 respondents that applied measures on their own accord. Of those indicating the question was applicable to  
253 their situation, in Italy, 60.6% kept their children at home before protective measures compared to 53.6%  
254 in the Netherlands and 58.1% in Germany.

255

### 256 **Subgroup analyses among respondents living in the Netherlands**

257

258           Although we conducted no formal comparisons between the sociodemographic subgroups of  
259 participants, some patterns were evident (Supplemental Tables 2a-2r). In general, while there were no  
260 meaningful differences in the degree of belief in the effectiveness of protective measures among gender  
261 groups, females applied these measures most frequently. Among the different age groups, the belief in the  
262 effectiveness of a complete social lockdown differed (e.g.  $\leq 20$  years: 47.5%, 21-40 years: 62.7%), as well  
263 as among subgroups with different daily activities (e.g. retired: 55.4%, homemaker/unemployed: 64.7%)  
264 and different education levels (primary/secondary: 54.6%, tertiary academic: 61.1%). Chronically ill  
265 patients more frequently reported exhibiting protective measures than respondents without any chronic  
266 diseases. Different sociodemographic subgroups used different sources of information to obtain  
267 information related to the COVID-19 pandemic. With higher age, the percentage of respondents who  
268 agreed they felt sufficiently informed was higher (for example:  $\leq 20$  years: 87.0%, versus  $> 60$  years:  
269 94.9%)

270

271

#### 272 **Change in responses over time**

273

274           Immediately following the primary data collection period, we continued collecting data over the  
275 next seven days (March 30th, 2020, 11.40 AM, UTC+0) and received responses from 1,588 additional  
276 participants, of whom 1,365 reported living in the Netherlands (n=858), in Germany (n=413) and in Italy  
277 (n=94). In general, we observed no substantial changes over time (Supplemental Figures 1a-1b), except  
278 for a decrease in the belief of effectiveness of a complete social lockdown in Germany (Supplemental  
279 Figure 1a). Furthermore, among respondents from the Netherlands, we observed a small increase in the  
280 percentages of respondents indicating they believe in the effectiveness of preventive measures (range: 0%-  
281 5%) and those indicating they implemented these measures (range: 0%-10%) across both data collection  
282 periods (Supplemental Figures 2a-2b).

## 283 **DISCUSSION**

284 Our findings indicate that in three European countries, the Netherlands, Germany, and Italy, the  
285 public belief in the effectiveness and the actual implementation of certain protective measures during the  
286 ongoing COVID-19 pandemic in March of 2020 was high. Furthermore, residents reported to be  
287 sufficiently informed about the ongoing pandemic using various communication channels.

288 The public belief in the effectiveness of protective measures was highest among respondents  
289 residing in Italy, which had the most extensive measures of social lockdown as well as the highest  
290 numbers of COVID-19 cases and deaths in Europe in March 2020. Compared to the Netherlands and  
291 Germany, respondents living in Italy most often reported not only exhibiting behaviors related to  
292 government imposed restrictions but also voluntary hygienic and social measures. Although in general,  
293 more than 90% of respondents indicated belief in the effectiveness of imposed measures of social  
294 distancing, a complete social lockdown was deemed effective by only 59% of respondents residing in the  
295 Netherlands (compared to 77% in Germany and 87% in Italy), where at the time of survey completion,  
296 only lighter social distancing measures were enforced. The results of our study suggest that the level of  
297 community containment measures implemented by national governments may be rapidly visible in the  
298 public beliefs about protective measures, the extent to which people actually exhibit these relevant  
299 behaviors, and reflect the severity of the outbreak situation in a given country.

300 To the best of our knowledge, to date, few data on this topic are available. Results from two  
301 recently published survey studies conducted in the USA, the UK, and China primarily focus on the  
302 respondents' knowledge about COVID-19 and assess understanding pertaining to the disease  
303 course[13,14]. Furthermore, another study conducted between January 24th and February 13th, 2020  
304 among 1715 Hong Kong residents showed that most respondents obtained information on the COVID-19  
305 pandemic from social media and websites[15]. We found that traditional information sources (e.g.  
306 television and news) were used most frequently among our respondents. Our study further corroborates  
307 and adds to these first findings with similar results regarding beliefs in the effectiveness of hygienic and  
308 social distancing measures and the extent to which these measures were exhibited in a European study  
309 population.

### 310 **Social distancing and other behavioral measures**

311 Individuals' adherence to country-specific mitigation measures has the potential to influence the  
312 course of the COVID-19 pandemic. Social (physical) distancing has been proposed as one of the most  
313 effective measures for mitigating pandemics caused by viruses, including COVID-19[4,7,16]. Large-scale  
314 simulation studies have found that closure of borders is only effective to prevent further spread of the

315 virus if they are implemented for more than two weeks and prevent international travel [8]. Moreover, the  
316 peak attack rate can be decreased by case isolation, household quarantine, and school, university and work  
317 closure[8].

318 As the transmissibility of the SARS-CoV-2 virus is estimated to be similar to or higher than  
319 previous coronaviruses such as SARS, social isolation measures are particularly important [17,18]. In the  
320 current COVID-19 pandemic, models have shown that the Wuhan quarantine reduced transmission of  
321 COVID-19 cases from mainland China to other countries by 77% by early February [9]. Besides social  
322 distancing, other behavioral protective measures have also been deemed effective in the mitigation of the  
323 current pandemic. For instance, regular hand washing may result in a reduction of peak infection rate up to  
324 65% with a delay of 2.7 months and a 29% decrease in total infection rate[19]. Generally, preventive,  
325 precautionary behavior is more commonly observed, in females, and in older persons [20–22], which was  
326 also reflected in our findings from Europe during the ongoing COVID-19 pandemic.

### 327 **Provision and acquirement of information during pandemics**

328 Transparent, timely, and easy-to-understand information is essential to increase trust in national  
329 governments during pandemics[23]. The increasing use of portable devices and social media is evident in  
330 our findings, which indicate frequent use of social media to acquire pandemic-related information (range  
331 across countries: 40.0%-55.8%). However, in recent epidemics and pandemics, a substantial amount of  
332 online information, especially distributed via social media, was found to be incorrect and  
333 misleading[24,25]. Environmental cues to follow behavioral recommendations, favorable attitudes  
334 towards prevention measures, and knowledge about the virus were associated with exhibiting protective  
335 behavior[5]. Therefore accurate information provision via social media channels is crucial, besides  
336 information via traditional information sources.

### 337 **Study strengths and limitations**

338 Given the evolving pandemic situation, we felt it was important to develop, translate, and  
339 disseminate our questionnaire rapidly to capture a snapshot of public perceptions and behaviors in ‘real  
340 time’ as the COVID-19 crisis unfolded in Europe and as policy makers enacted formal containment  
341 measures in several European countries. Many items in our survey were adapted from an existing  
342 validated questionnaire created to assess perceptions and behaviors in response to influenza[10]. We  
343 attempted to make our survey accessible to participants of diverse backgrounds by providing the survey in  
344 eight languages. These translations could be readily adapted for use in future studies on other viral  
345 pandemics.

346 Readers should consider some important limitations when interpreting our findings. First, since  
347 the survey was web-based and recruitment was largely through digital channels including social media, we  
348 acknowledge the potential for selection bias. We cannot assume that our study population is representative  
349 for the individual countries and acknowledge possible over-representation of health-conscious individuals  
350 and those more informed or concerned about the outbreak. However, under the exceptional current  
351 circumstances, members of the general public who normally would not participate in health-related  
352 surveys may be more likely to participate given the media attention, severity, and the outbreak's large  
353 impact on many aspects of daily life. Furthermore, with the social (physical) distancing recommendations  
354 and enforced measures in place, many confined to their homes have turned to social media and other web-  
355 based platforms for social communication, including those belonging to the older age groups.

356 Second, the number of completed survey responses was much higher among residents of the  
357 Netherlands compared to Italy or Germany. Since the majority of our research team members are based in  
358 the Netherlands and the largest dissemination efforts occurred there, this is not surprising. Third, while the  
359 governments of Germany, Italy, and the Netherlands enacted different mitigation measures in each  
360 country, our survey was not adapted to country-specific nuances. Hence, we acknowledge that our results  
361 might not fully depict whether residents of these countries actually exhibit their country-specific  
362 measures. Fourth, we cannot rule out that an individual completed the survey more than once on multiple  
363 devices, in another browser, or by clearing cookies; however, repeat submissions from the same device  
364 were not accepted.

365 Fifth, with regard to the secondary analysis over the extended data collection period, we observed  
366 no major changes in the aggregated answers over time; however, we acknowledge a possible delay  
367 between the implementation of formal community isolation measures and the subsequent information  
368 uptake and application of these measures by residents. During the extended data collection period,  
369 response rates were lower than in the primary collection period, especially from respondents living in  
370 Italy.

371 Finally, we emphasize the aim of our study was descriptive, and we caution readers against  
372 drawing causal conclusions regarding the observed differences. A formal comparison between countries  
373 would require appropriate analytical consideration of variables taking into account sociocultural  
374 (including educational systems), political, and structural contexts in each country. In an effort to help the  
375 reader better understand each country-specific setting we included information about the stage of  
376 containment measures enacted within the included countries in a timeline encapsulating the data collection  
377 period.

378

379 **CONCLUSION**

380           The extent to which individuals internalize and respond to (government-mandated) mitigation  
381 measures and recommendations is critical to the control of the spread of the SARS-CoV-2 virus and to  
382 optimize outcomes during the current COVID-19 pandemic. In our survey study of the general public  
383 living in the Netherlands, Germany, and Italy, we found that approval and application of publicly enforced  
384 and self-initiated protective measures were highest in Italy, the region with the most extensive measures of  
385 social lockdown and highest burden (number of cases and deaths) in Europe, during the study time period  
386 in mid-March, 2020. Media channels used to acquire information and the extent to which respondents felt  
387 sufficiently informed about the COVID-19 pandemic differed per country and among sociodemographic  
388 subgroups in the Netherlands. No substantial changes in the perceived effectiveness of behavioral  
389 protective measures and the implementation of these measures in these countries were observed between  
390 March 19th and March 30th, 2020, as the COVID-19 pandemic continued to evolve in Europe and formal  
391 community isolation measures became stricter. We believe these insights are valuable to inform the  
392 information dissemination and infection control strategies of governments and public health organizations  
393 during the current crisis and also for future pandemics.

## 394 **Summary boxes**

### 395 *What is already known on this topic*

- 396 ● Social distancing and hygienic measures are effective in mitigating pandemics such as the  
397 COVID-19 pandemic.
- 398 ● Public beliefs regarding the effectiveness of protective measures, and the extent to which these  
399 measures have been applied by European residents during the COVID-19 pandemic remain  
400 unknown.

### 401 *What this study adds*

- 402 ● In three European countries, the degree of public belief in the effectiveness of protective measures  
403 was high and respondents living in the Netherlands, Germany and Italy reported feeling  
404 sufficiently informed by various communication channels.
- 405 ● Implementation of enacted and self-initiated measures differed between countries and were  
406 highest among respondents living in Italy, who were subjected to the most elaborate measures of  
407 social lockdown and experienced the greatest outbreak burden.

408 **Contributors:** AHZN conceived this study and AHZN, KM, and JLR developed the study design. All  
409 authors contributed to design the survey, translation and verification of the survey items in German, Dutch  
410 or Italian, and distribution of the survey in social and professional networks. KM, TG, MP, and RM  
411 conducted the statistical analysis and data visualization. MCG and ATCJ classified countries on  
412 containment stage. KM, JLR and AHZN drafted the manuscript with support from MM, KA, ATCJ, TG  
413 and MP. The COVID-19 study group contributed to translation, pilot testing of the survey, dissemination,  
414 and country community isolation measure classification. All authors and study group members helped  
415 interpret the results and critically revised the final manuscript. AHZN supervised the project. The  
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431 the Institutional Review Board of Leiden University Medical Center in The Netherlands (protocol number:  
432 N20-037).

433 **Data sharing:** Requests for data sharing can be directed to AHZN: [a.h.zamanipoor@lumc.nl](mailto:a.h.zamanipoor@lumc.nl). All survey  
434 items are included as supplemental material.

435 **Transparency:** The corresponding author (AHZN) affirms that this manuscript is an honest, accurate, and  
436 transparent account of the study being reported; that no important aspects of the study have been omitted;  
437 and that any discrepancies from the study as planned have been explained.

438 **Patient and Public Involvement:** The target population, the general public, was actively involved in the  
439 dissemination of this survey. No patients were involved in this study, as the target group was the general  
440 public.

441 **Dissemination declaration:** Upon request, the data will be available for policy makers and government  
442 bodies.

443



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512

513 **FIGURE CAPTIONS**

514

515 **Figure 1.** Flow chart of respondents in survey, on March 23rd, 2020.

516

517 **Figure 2.** Being informed about and belief in the effectiveness of policy recommendations during the  
518 COVID-19 pandemic on March 23rd, 2020, by country.

519 Note: Response percentages are rounded and may not add up to 100%. Percentages below 5% omitted.

520

521 **Figure 3.** Individual implementation of protective measures in response to COVID-19 pandemic on  
522 March 23rd, 2020, by country.

523 Note: Response percentages are rounded and may not add up to 100%. Percentages below 5% omitted.

524

525 Table 1. *Sociodemographic characteristics of respondents on March 23rd, 2020, by country.*

	<b>Netherlands (Stage III)</b>	<b>Germany (Stage III)</b>	<b>Italy (Stage IV)</b>	<b>Total</b>
No.	8,611	604	581	9,796
<b>Gender (%)</b>				
Male	2,492 (28.9)	206 (34.1)	192 (33.1)	2,890 (29.5)
Female	6,095 (70.8)	389 (64.4)	388 (66.8)	6,872 (70.2)
Other	24 (0.3)	9 (1.5)	1 (0.2)	34 (0.4)
<b>Age, years (%)</b>				
≤20 years	675 (7.8)	11 (1.8)	117 (20.1)	803 (8.2)
21-30 years	2,867 (33.3)	222 (36.8)	189 (32.5)	3,278 (33.5)
31-40 years	1,167 (13.6)	223 (36.9)	99 (17.0)	1,489 (15.2)
41-50 years	1,278 (14.8)	70 (11.6)	75 (12.9)	1,423 (14.5)
51-60 years	1,558 (18.2)	47 (7.8)	73 (12.6)	1,678 (17.1)
61-70 years	852 (9.9)	23 (3.8)	26 (4.5)	901 (9.2)
> 70 years	214 (2.5)	8 (1.3)	2 (0.3)	224 (2.3)
<b>Daily activity (%)</b>				
Paid job	4,885 (56.7)	388 (64.2)	321 (55.3)	5,594 (57.1)
Homemaker/Unemployed	573 (6.7)	41 (6.8)	37 (6.4)	651 (6.7)
Student	2,272 (26.4)	131 (21.7)	199 (34.3)	2,602 (26.6)
Retired	557 (6.5)	20 (3.3)	12 (2.1)	589 (6.0)
Other	324 (3.8)	24 (4.0)	12 (2.1)	360 (3.7)
<b>Household composition (%)</b>				
Single	1,391 (16.2)	113 (18.7)	94 (16.2)	1,598 (16.3)
Parent(s) with child(ren)	2,740 (31.8)	174 (28.8)	135 (23.2)	3,049 (31.1)
Living with partner	2,339 (27.2)	189 (31.3)	94 (16.2)	2,622 (26.8)
Shared flat (with roommates)	1,558 (18.1)	112 (18.5)	34 (5.9)	1,704 (17.4)
Other	583 (6.8)	16 (2.7)	224 (38.6)	823 (8.4)
<b>Highest educational qualification (%)</b>				
Primary/Secondary	635 (7.4)	132 (21.9)	301 (51.8)*	1068 (10.9)
Tertiary vocational	1,991 (23.1)	57 (9.4)		2048 (20.9)
Tertiary academic	5,985 (69.5)	415 (68.7)	280 (48.2)	6,680 (68.2)
<b>Healthcare provider/(bio-)medical student (%)</b>				
	1,572 (18.3)	123 (20.4)	48 (8.3)	1,743 (17.8)
<b>Chronic illness or being in poor medical condition (%)</b>				
	1,528 (17.7)	103 (17.1)	64 (11.0)	1,695 (17.3)
<b>Sources used to acquire information on COVID-19 (%)</b>				
Television	6,613 (76.8)	320 (53.0)	476 (82.0)	7,409 (75.6)
Newspaper, mobile news application	5,422 (63.0)	295 (48.8)	180 (31.0)	5,897 (60.2)
Social media	3,441 (40.0)	277 (45.9)	324 (55.8)	4,042 (41.3)
Radio	1,077 (12.5)	161 (26.7)	31 (5.3)	1,269 (13.0)
Official health hotlines	127 (1.5)	7 (1.2)	9 (1.6)	143 (1.5)
Official health websites	3,361 (39.0)	327 (54.1)	268 (46.1)	3,956 (40.4)
Healthcare professionals	381 (4.4)	26 (4.3)	44 (7.6)	451 (4.6)
People I speak to on a daily basis	2,293 (26.6)	161 (26.7)	139 (23.9)	2,593 (26.5)

*For full questionnaire and wording, see Supplement 1.*

\* *Based on differences in the Italian education system, we considered primary, lower secondary school and upper secondary school as “Primary/Secondary” and university degrees as “Tertiary academic”.*

527 Table 2. *Being informed about and belief in the effectiveness of policy recommendations during the*  
 528 *COVID-19 pandemic on March 23rd, 2020, by country.*

		<b>Netherlands (Stage III)</b>	<b>Germany (Stage III)</b>	<b>Italy (Stage IV)</b>
No.		8,611	604	581
<b>Have been sufficiently informed (%)</b>	Probably true	7,839 (91.0)	545 (90.2)	529 (91.1)
	Probably false	271 (3.2)	23 (3.8)	29 (5.0)
	Not sure	476 (5.5)	33 (5.5)	21 (3.6)
	No opinion	25 (0.3)	3 (0.5)	2 (0.3)
<b>Belief in effectiveness of recommendations (%)</b>				
Avoid social gatherings	Probably true	8,479 (98.9)	594 (98.5)	576 (99.7)
	Probably false	60 (0.7)	4 (0.7)	2 (0.4)
	Don't know	31 (0.4)	5 (0.8)	0 (0.0)
	Missing	41	1	3
Selective closure of public places/locations	Probably true	8,158 (95.3)	586 (97.2)	568 (98.1)
	Probably false	234 (2.7)	13 (2.2)	11 (1.9)
	Don't know	172 (2.0)	4 (0.7)	0 (0.0)
	Missing	47	1	2
Implementation of hand hygiene measures	Probably true	8,240 (96.0)	589 (98.2)	567 (98.1)
	Probably false	169 (2.0)	4 (0.7)	8 (1.4)
	Don't know	169 (2.0)	7 (1.2)	3 (0.5)
	Missing	33	4	3
Implementation of respiratory measures	Probably true	8,139 (95.0)	583 (97.3)	569 (99.0)
	Probably false	230 (2.7)	9 (1.5)	4 (0.7)
	Don't know	196 (2.3)	7 (1.2)	2 (0.4)
	Missing	46	5	6
Complete social lockdown/isolation	Probably true	5,063 (59.2)	458 (76.6)	495 (87.2)
	Probably false	1,983 (23.2)	72 (12.0)	29 (5.1)
	Don't know	1,500 (17.6)	68 (11.4)	44 (7.8)
	Missing	65	6	13

*For full questionnaire and wording, see Supplement I.*

*Response percentages may not add up to 100% due to rounding.*

529 Table 3. Individual implementation of protective measures in response to COVID-19 pandemic on March  
 530 23rd, 2020, by country.

No.	Netherlands (Stage III)				Germany (Stage III)				Italy (Stage IV)			
	8,611				604				581			
Personal protective behaviors (%)	Y	N	NS	NA	Y	N	NS	NA	Y	N	NS	NA
Cleaned or disinfected things you might touch more often than usual	4,083 (47.8)	3,753 (43.9)	713 (8.3)	62	292 (48.9)	264 (44.2)	41 (6.9)	7	423 (73.2)	123 (21.3)	32 (5.5)	3
Carried sanitizing hand gel with you when out and about	2,385 (28.3)	5,871 (69.6)	181 (2.2)	174	277 (47.0)	302 (51.2)	11 (1.9)	14	424 (73.5)	147 (25.5)	6 (1.0)	4
Used sanitizing hand gel to clean your hands, more often than usual	4,681 (55.3)	3,601 (42.5)	186 (2.2)	143	424 (71.5)	157 (26.5)	12 (2.0)	11	442 (76.6)	125 (21.7)	10 (1.7)	4
Reduced the amount you touch your eyes, nose and/or mouth	4,208 (49.0)	2,491 (29.0)	1,889 (22.0)	23	374 (62.2)	87 (14.5)	140 (23.3)	3	439 (75.7)	77 (13.3)	64 (11.0)	1
Followed a healthy diet or took vitamin supplements	4,548 (54.5)	3,429 (41.1)	370 (4.4)	264	317 (54.4)	226 (38.8)	40 (6.9)	21	205 (36.3)	308 (54.5)	52 (9.2)	16
Usually carried tissues with you when out and about	4,399 (52.4)	3,833 (45.7)	163 (1.9)	216	400 (69.7)	157 (27.4)	17 (3.0)	30	472 (83.0)	83 (14.6)	14 (2.5)	12
Usually used tissues when sneezing or coughing	4,542 (62.0)	2,551 (34.8)	232 (3.2)	1,286	335 (62.5)	169 (31.5)	32 (6.0)	68	468 (81.8)	82 (14.3)	22 (3.9)	9
Washed your hands with soap and water more often than usual	8,176 (95.0)	371 (4.3)	56 (0.7)	8	576 (95.7)	23 (3.8)	3 (0.5)	2	561 (96.6)	17 (2.9)	3 (0.5)	0
Kept child(ren) at home before any mandates were put in place	1,151 (53.6)	957 (44.6)	38 (1.8)	6,465	111 (58.1)	75 (39.3)	5 (2.6)	413	208 (60.6)	97 (28.3)	38 (11.1)	238
Limiting interactions with people (%)	Y	N	NS	NA	Y	N	NS	NA	Y	N	NS	NA
Cancelled or postponed a social event	8,042 (94.8)	268 (3.2)	178 (2.1)	123	580 (97.0)	11 (1.8)	7 (1.2)	6	572 (98.8)	6 (1.0)	1 (0.2)	2
Kept away from crowded places	7,834 (92.4)	367 (4.3)	277 (3.3)	133	555 (93.8)	22 (3.7)	15 (2.5)	12	575 (99.3)	3 (0.5)	1 (0.2)	2
Tried to avoid people who have the cold or flu-like symptoms	7,523 (89.0)	514 (6.1)	414 (4.9)	160	469 (81.1)	63 (10.9)	46 (8.0)	26	515 (90.2)	31 (5.4)	25 (4.4)	10
Avoiding travel (%)	Y	N	NS	NA	Y	N	NS	NA	Y	N	NS	NA
Reduced the amount of going to school/university/work	6,446 (88.0)	839 (11.5)	43 (0.6)	1,283	478 (84.9)	81 (14.4)	4 (0.7)	41	535 (94.4)	31 (5.5)	1 (0.2)	14
Reduced use of or change the way you use public transport	5,521 (89.6)	511 (8.3)	127 (2.1)	2,452	493 (91.3)	41 (7.6)	6 (1.1)	64	562 (98.6)	5 (0.9)	3 (0.5)	11
Reduced the amount you go to shops	6,888 (81.4)	1,154 (13.6)	421 (5.0)	148	401 (67.5)	134 (22.6)	59 (9.9)	10	563 (97.7)	8 (1.4)	5 (0.9)	5
Other behaviors not mentioned	2,094 (25.6)	5,335 (65.2)	760 (9.3)	422	166 (28.5)	316 (54.2)	101 (17.3)	21	254 (44.0)	274 (47.5)	49 (8.5)	4

Y = Yes; N = No; NS = Not sure; NA = Not applicable. For full questionnaire and wording, see Supplement I.  
 Response percentages may not add up to 100% due to rounding.



**Opened survey (n=12,018)**

**Did not give consent (n=248)**

**Did not finish (n=1,026)**

**Finished survey (n=10,744)**

**Respondents from countries with less than 500 respondents (n=948)**

**Respondents from countries with 500 respondents or more (n=9,796)**

**Netherlands (n=8,611)**

Survey link was opened by...

Facebook	(n=3,019)
Twitter	(n=470)
Instagram	(n=125)
LinkedIn	(n=211)
WhatsApp	(n=3,988)
News	(n=216)
Other	(n=582)

**Germany (n=604)**

Survey link was opened by...

Facebook	(n=111)
Twitter	(n=26)
Instagram	(n=0)
LinkedIn	(n=20)
WhatsApp	(n=307)
News	(n=2)
Other	(n=138)

**Italy (n=581)**

Survey link was opened by...

Facebook	(n=88)
Twitter	(n=0)
Instagram	(n=8)
LinkedIn	(n=1)
WhatsApp	(n=442)
News	(n=4)
Other	(n=38)



**Netherlands**  
(N = 8611)

**Germany**  
(N = 604)

**Italy**  
(N = 581)



